NEMS-CLARKE EQUIPMENT

INSTRUCTION BOOKLET

August 1970

MODEL PTD-105G
PHASE TRACKING DEMODULATOR

The Model PTD-105G Phase Tracking Demodulator is designed for use with the NEMS-Clarke R-1037G series receivers having phase demodulation capabilities. The demodulator comprises the second i-f bandwidth filter and the loop filter bandwidth and reset controls. The PTD-105G is in the form of a front panel plug-in module. The electrical specifications are given below:

Demodulator:

Video Frequency Response . .	20 Hz to 50 kHz (lower video bandwidth limit determined by setting of LOOP BANDWIDTH switch).
Carrier Tracking Loop Bandwidth	20 Hz, 100 Hz, and 275 Hz.
Demodulator Linearity	within 1% for phase deviations of ±115°.
Type of Loop	second order loop around second local oscillator.
Locking Threshold	-140 dBm.
Tracking Range	±15 kHz from frequency set with manual VFO control.

IF Filter:

Type	eight-pole Butterworth LC.
Center Frequency	10.000 MHz.
Bandwidth	300 kHz ±10% at 3 dB points.

INSTALLATION

The PTD-105G demodulator is a complete subassembly plug-in module. All electrical connections are made automatically as the unit is inserted into the receiver main chassis. There are no cables to be manually connected during installation, or disconnected during removal.

Defense Electronics
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To install the demodulator, insert it through the appropriate opening in the receiver front panel; once in place, tighten the knurled thumbscrews.

To remove the demodulator, loosen the thumbscrews, then withdraw the unit from the receiver main chassis.

OPERATION

Once installed in the receiver, the PTD-105G becomes an integral functional part of the receiver. Thus, the operating procedures for the demodulator are included in the operating instructions for the overall receiver; see the operation section of the receiver instruction manual.

To supplement the receiver's operating instructions, a functional description of the demodulator's operating controls and a setup procedure are given in the following paragraphs.

Operating Controls and Indicators

LOOP BANDWIDTH switch . . 20 Hz, 100 Hz, 275 Hz	.This control establishes the bandwidth of the tracking loop and also the lower video rolloff point. In the 275 Hz position, the loop will track and demodulate input signals with carrier frequency shifts as great as ±15 kHz from center frequency providing these shifts do not occur at a rate greater than 275 Hz. In the 275 Hz position, the lower 3 dB video rolloff point occurs at 275 Hz. This means that the received signal must be modulated at a deviation rate greater than 275 Hz. These same statements apply to the 20 Hz and 100 Hz positions with the governing rate of frequency jitter and modulation rate being 20 Hz and 100 Hz respectively. In all cases, the upper video rolloff point is established by the position of the receiver VIDEO FILTER selector switch.
RESET switch	This switch disables the loop so that it may be locked with the VFO control.
LOCK lamp	This lamp indicates, when lit, that the phase loop is locked.

Setup Procedures

a. Set the 2ND LOC OSC switch to the VFO position. This energizes the voltage-controlled crystal oscillator and the buffer amplifier in the first i-f amplifier module.

b. Ensure that the first local oscillator (in the rf tuner module) is operating in the XTAL mode.

c. Set the LOOP BANDWIDTH switch on the PTD module to the desired position.

d. Ensure that signal strength meter indicates that the desired signal is present.

e. Depress the RESET switch on the PTD module and rotate the VFO control until a zero beat is achieved. Release the RESET switch and observe that the LOCK indicator lamp glows steadily.

PRINCIPLES OF OPERATION

The PTD-105G functions in conjunction with the Tracking Loop Module, the Phase Comparator Module, and the Voltage-Controlled (second l-o) Oscillator in the receiver, to provide the receiver with phase demodulation capabilities.

The demodulator comprises the second i-f bandwidth filter and the loop filter bandwidth and reset controls.

IF Bandwidth Filter

The i-f bandwidth filter is composed of an eight-pole Butterworth LC network having a center frequency of 10.000 MHz and an i-f bandwidth of 300 kHz. The filter with its sharp skirt selectivity determines the overall receiver bandwidth.

The output of the First IF Amplifier and Converter Module in the receiver is applied to the filter through A2 on P1. From A2-P1, the i-f signal is applied to the tapped inductance L1.

The L1 tap is set to provide a 50 ohm input impedance to match the output impedance of the First IF Amplifier and Converter Module in the receiver. Inductor L1 is tuned by capacitor C1 and variable capacitor C35. Energy from the first resonant circuit or pole is capacitively coupled through C2 to the next resonant network. The coupling capacitances and inductances and the L to C ratio of eight resonant circuits vary to obtain the required maximally flat response. The output inductor L8 is tapped to produce a 50 ohm output impedance. The output of the i-f bandwidth filter is applied through J1 to the Second IF Wideband Amplifier Module in the receiver.

Loop Filter

The loop filter bandwidth switch and the reset control receive their input from the loop phase detector located in the tracking loop module in the receiver. This input is applied through pins 3 and 9 of connector P1. The loop bandwidth switch permits selection of loop bandwidths of 20 Hz, 100 Hz, and 275 Hz.

The function of the loop filter is to filter out the phase fluctuations which are the result of the normal modulation process. The loop filter does not permit the tracking loop to respond to the higher phase fluctuations. This loop filter has three bandwidths which are selected by the loop bandwidth filter in the demodulator. The selected loop bandwidth is the highest carrier deviation rate which the loop will track. The loop bandwidth switch setting also establishes the lower video rolloff point. For example, in the 275 Hz position, the phase loop will track a phase modulation rate below 275 Hz causing any intelligence contained in the carrier below this phase deviation rate to be absorbed by the phase tracking loop.

The reset switch, S2, disables the phase loop (shorting out the loop bandwidth switch), permitting the loop to be manually locked by the operator.

The loop lock indicator, DS1, receives its input from the lock indicator phase detector in the tracking loop module located in the receiver. This input is routed through pin 2 of connector P1. The indicator will light when the loop is locked.

MAINTENANCE

Knowledge of the principles of operation as given in preceding paragraphs and familiarity with the schematic diagram shown in figure 4 are necessary prior to troubleshooting the PTD-105G.

The first check should be to ensure the fault is located in the demodulator. To do this, ensure the correct inputs are being applied to the demodulator.

Once the fault has been isolated to the demodulator, signal tracking methods can be employed to locate the defective stage or stages. After repairs have been made, the alignment of the particular circuit should be checked.

Alignment

Alignment is required only for the second i-f bandwidth filter section of the demodulator. There are no adjustable components in the loop filter bandwidth and reset section. The procedure is as follows:

Recommended Equipment:

6 dB 50 ohm Pad	High Impedance Diode Probe
50 ohm Coaxial RF Detector	Module Extension Test Cable

Recommended Equipment, continued

Sweep Generator	Jerrold 602
Signal Generator	HP 606A
Oscilloscope	Tektronix 130C
Electronic Counter	HP 5245L

NOTE

The frequency of the signal generator being used for a marker, in this case the HP 606A signal generator, must be set precisely at 10.000 MHz utilizing the electronic counter.

a. Set up the test equipment as shown in figure 1 using connecting cables wherever possible. The 50 ohm detector should remain connected to the output of the filter during steps b through g.

b. Connect the high impedance diode probe to the top of coil L1 (connecting leads must be as short as possible).

c. Short circuit the top of L2 to ground, using a very short cliplead at the feed-thru terminal.

d. Adjust a 10.000 MHz marker input so that a mark can be seen on the oscilloscope. Adjust C35 in the first stage for a maximum response at 10.000 MHz, as shown in figure 2, response No. 1 (during the alignment procedure vary the amplitude and sweep width of the generator, as necessary, to provide the sharpest tuning).

e. Remove the short circuit from L2 and short circuit the top of L3 to ground. Adjust C4 for a minimum response at 10.000 MHz, as shown in figure 2, response No. 2 (the high impedance diode probe is left in the first stage during the entire alignment procedure).

f. Remove the short circuit from L3 and short circuit L4. Adjust C7 for maximum response at 10.000 MHz, as shown in figure 2, response No. 3.

g. Remove the short circuit from L4 and short circuit L5. Adjust C10 for minimum response at 10.000 MHz, as shown in figure 2, response No. 4.

h. Reverse the connections to the filter (i.e. connect the 50 ohm detector to P1-A2 and connect the 6 dB, 50 ohm pad to P1-A1).

i. Remove the high impedance diode probe from L1 and connect it to the top of L8.

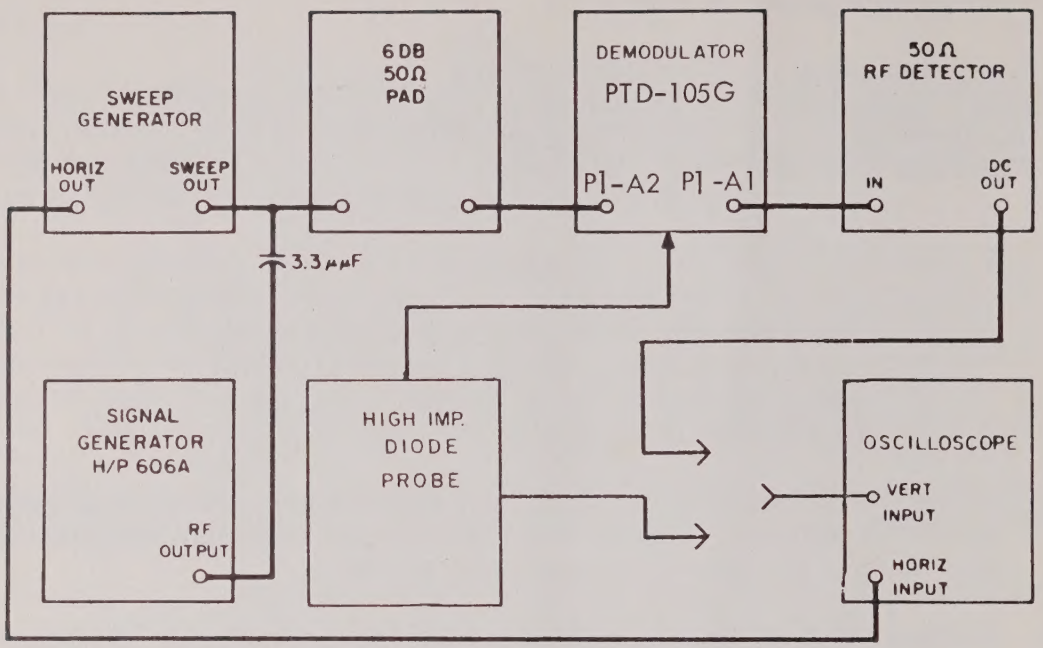


Figure 1. Test Setup

j. Short circuit the top of L7 to ground and adjust C39 for a maximum response at 10.000 MHz, as shown in figure 2, response No. 1.

k. Remove the short circuit from L7 and short circuit L6. Adjust C36 for minimum response at 10.000 MHz, as shown in figure 2, response No. 2.

l. Remove the short circuit from L6 and short circuit L5. Adjust C16 for maximum response at 10.000 MHz, as shown in figure 2, response No. 3.

m. Remove the short circuit from L5 and short circuit L4. Adjust C13 for minimum response at 10.000 MHz, as shown in figure 2, response No. 4.

n. Reconnect the equipment as shown in figure 1 (do not connect the high impedance diode probe to L1) and view the overall filter response, it should be as shown on figure 2, response No. 5. If the response is slightly unsymmetrical, a slight adjustment of the first and last tuning capacitors should correct this. If the overall response is very poor, the entire alignment procedure should be repeated very carefully to adjust the maximum and minimum points at precisely 10.000 MHz.

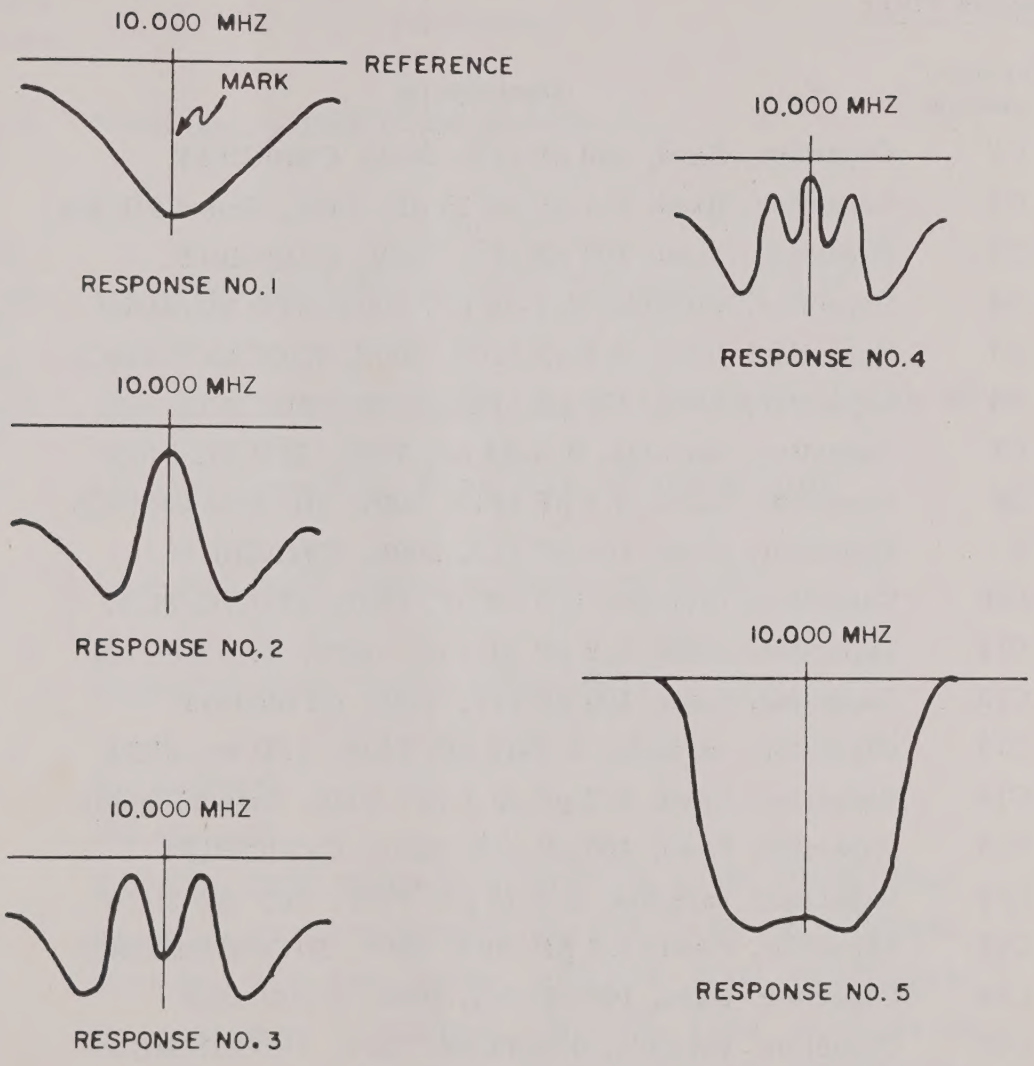


Figure 2. Oscilloscope Waveforms

ELECTRICAL PARTS LIST

Bandpass Filter

Reference Designation	Description
C1	Capacitor, fixed, 100 pF ±1%, 500V, CY10C101F
C2	Capacitor, fixed, 5.1 pF ±0.25 pF, 500V, Erie NPO-301
C3	Capacitor, fixed, 100 pF ±1%, 500V, CY10C101F
C4	Capacitor, variable, 0.8-12 pF, 750V, JFD VC-31GW
C5	Capacitor, fixed, 2.7 pF ±10%, 500V, R1CC22C0J279C5
C6	Capacitor, fixed, 100 pF ±1%, 500V, CY10C101F
C7	Capacitor, variable, 0.8-12 pF, 750V, JFD VC-31GW
C8	Capacitor, fixed, 2.7 pF ±10%, 500V, R1CC22C0J279C5
C9	Capacitor, fixed, 100 pF ±1%, 500V, CY10C101F
C10	Capacitor, variable, 0.8-12 pF, 750V, JFD VC-31GW
C11	Capacitor, fixed, 1.8 pF ±0.1 pF, 500V, Erie NPO-301
C12	Capacitor, fixed, 100 pF ±1%, 500V, CY10C101F
C13	Capacitor, variable, 0.8-12 pF, 750V, JFD VC-31GW
C14	Capacitor, fixed, 2.2 pF ±0.1 pF, 500V, Erie NPO-301
C15	Capacitor, fixed, 100 pF ±1%, 500V, CY10C101F
C16	Capacitor, variable, 0.8-12 pF, 750V, JFD VC-31GW
C17	Capacitor, fixed, 2.7 pF ±10%, 500V, R1CC22C0J279C5
C18	Capacitor, fixed, 100 pF ±1%, 500V, CY10C101F
C35	Capacitor, variable, 0.8-12 pF, 750V, JFD VC-31GW
C36	Capacitor, variable, 0.8-12 pF, 750V, JFD VC-31GW
C37	Capacitor, fixed, 5.1 pF ±0.25 pF, 500V, Erie NPO-301
C38	Capacitor, fixed, 100 pF ±1%, 500V, CY10C101F
C39	Capacitor, variable, 0.8-12 pF, 750V, JFD VC-31GW
L1	Inductor assembly, Nems-Clarke 101721-97
L2 through L7	Inductor assembly, Nems-Clarke 101721-99
L8	Inductor assembly, Nems-Clarke 101721-98

Demodulator

Reference Designation	Description
A1 through A3	Connector, Cannon DM53740-5008
C20 through C22	Capacitor, fixed, 0.1 uF ±20%, 25V, Sprague 5C7
C23 through C27	Capacitor, monolytic, fixed, 2.2 uF ±20%, 25V, Sprague 5C15
C28	Capacitor, tantalum, 47 uF, 25V, CL25BG470UP3
DS1	Indicator, lamp, cartridge, Amber 39-10-333
P1	Connector, plug, Cannon DBM-13W3P
R1	Not assigned
R2	Not assigned
R3	Resistor, fixed composition, 51Ω ±5%, 1/4W, RC07GF106J
R4	Resistor, fixed composition, 91k ±5%, 1/4W, RC07GF913J
R5	Resistor, fixed composition, 390k ±5%, 1/4W, RC07GF394J
R6	Resistor, fixed composition, 120k ±5%, 1/4W, RC07GF124J
R7	Resistor, fixed composition, 1.2k ±5%, 1/4W, RC07GF122J
R8	Resistor, fixed composition, 18k ±5%, 1/4W, RC07GF183J
R9	Resistor, fixed composition, 2.2 meg ±5%, 1/4W, RC07GF225J
S1	Switch, Nems-Clarke, 103092-90
S2	Switch, Grayhill #30-1

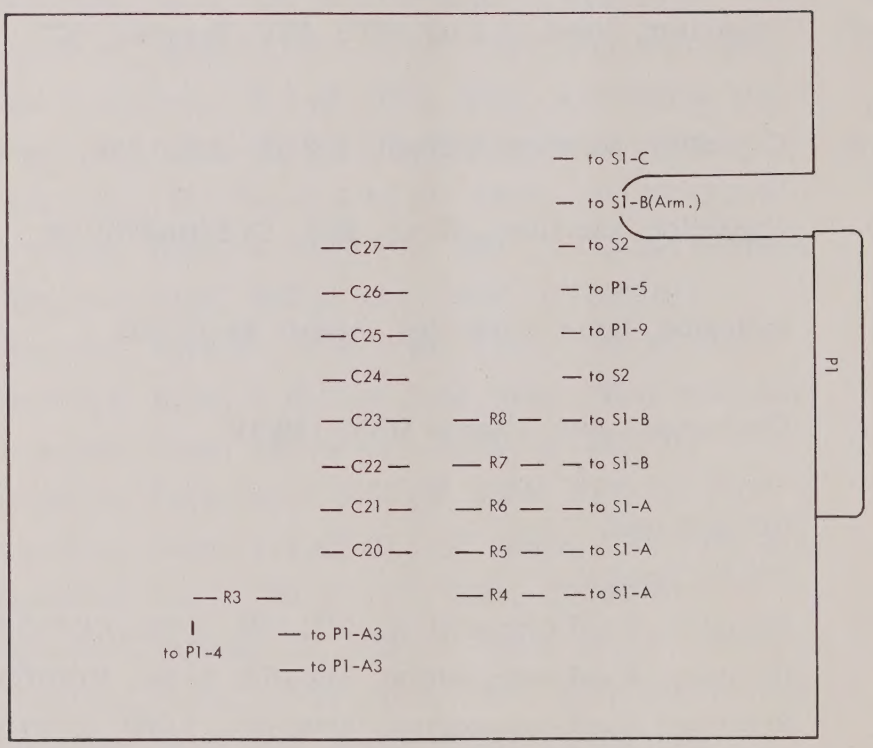
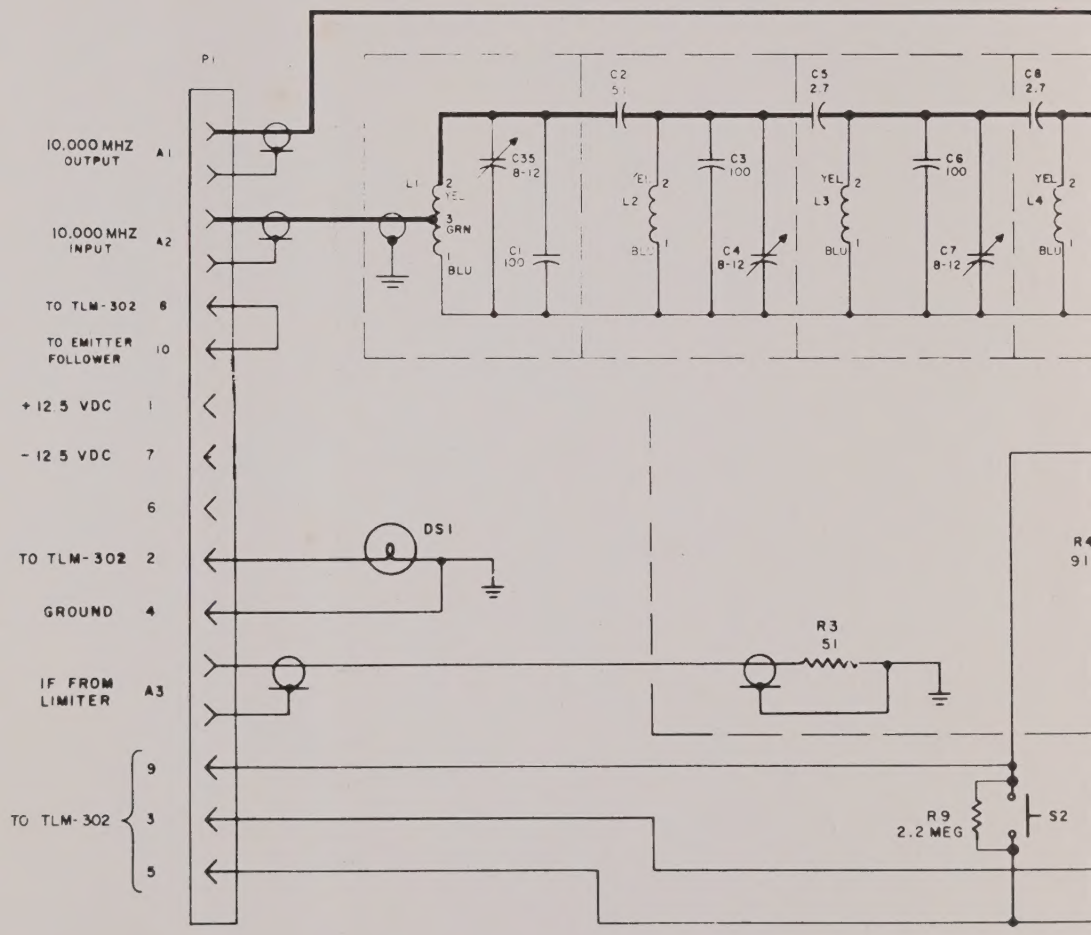


Figure 3. Demodulator Subassembly, Component Locations


P1
10.000 MHZ OUTPUT A1
10.000 MHZ INPUT A2
TO TLM-302 8
TO EMITTER FOLLOWER 10
+12.5 VDC 1
-12.5 VDC 7
6
TO TLM-302 2
GROUND 4
IF FROM LIMITER A3
TO TLM-302 9
3
5
L1
2 YEL
3 GRN
1 BLU
C35 8-12
C1 100
C2 5
L2
C3 100
C4 8-12
C5 2.7
L3
C6 100
C7 8-12
C8 2.7
L4
DS1
R3 51
R9 2.2 MEG
S2

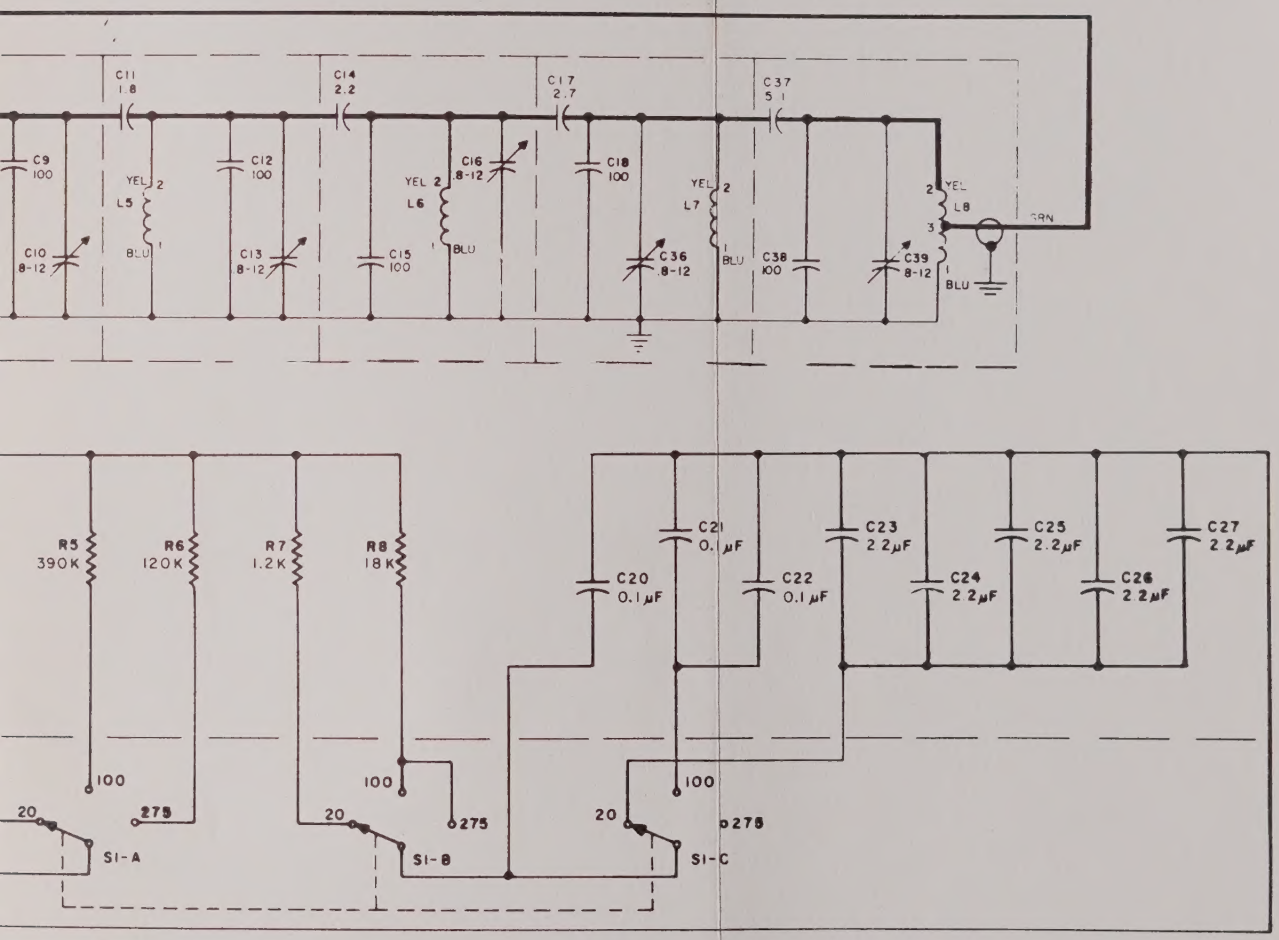
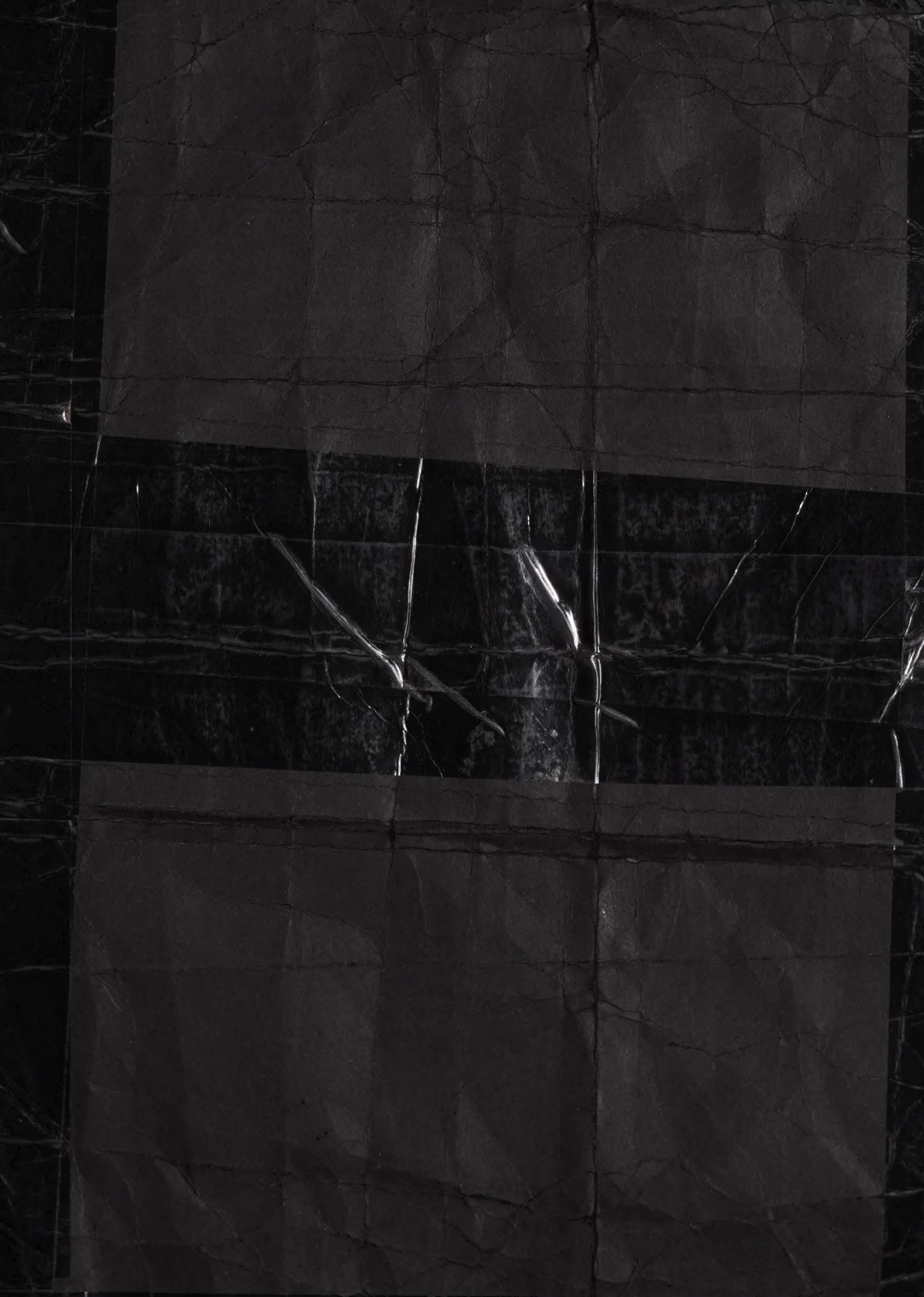


Figure 4. Model PTD-105G Phase Tracking Demodulator, Schematic Diagram



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